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Emergent Organization and Responsive Technologies in Crisis: Creating Connections or Enabling Divides?

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Abstract

I articulate and employ a situational boundary-making approach to study the emergence of organization and technology at a shelter during Hurricane Katrina. My analysis of qualitative data shows how emergent organization occurred at the shelter as *situational entanglements* consisting of three main elements: a salient moment in time, key actors, and boundary-making practices. Key actors' responses to salient moments in time enacted both distinction and dependency between organizational and technological actors, resulting in a divided organization. This analysis extends emergent approaches by showing how organization and technology are situationally organized and emerges through the (in)determinacy of meaning. Implications are also discussed for disaster managers to assess the success and failure of technology during a response.

Keywords

information and communication technology, organizational emergence, disaster response, organizational practice, interorganizational communication

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In the summer of 2005, over 10,000 Hurricane Katrina evacuees arrived in the City of Jackson[1] by the busloads, seeking refuge in the days prior to and following the disaster. Katrina left millions of Gulf Coast residents displaced from their homes and in serious need of food and shelter. City of Jackson officials responded to the onslaught of evacuees by opening one large shelter to house the many thousands arriving daily. Local businesses, community organizations, and a reported 13,000 individual volunteers came together to coordinate support and services at the shelter in a sustained relief attempt that lasted over 3 weeks.

This relief effort was the largest organization of people and resources that the City of Jackson had ever experienced. There was no prior plan in place, and there were no determined rules to follow. An overwhelming sense of urgency governed the decisions and interactions of the City of Jackson employees, local volunteer organizations, and community volunteers that organized the effort. Volunteers turned to technology in order to coordinate their efforts and connect evacuees to missing loved ones.

In this article, I investigate the emergence of organization and technology at the City of Jackson shelter. My analysis shows how emergence occurred at the shelter as *situational entanglements* consisting of three main elements: a salient moment in time, key actors, and boundary-making practices. Key actors at the shelter responded to salient moments in time, enacting both distinction and dependency between organizational and technological actors, resulting in a divided organization. Situational entanglement extends existing emergent approaches by showing how organization and technology are situationally organized and how emergence occurs through the (in)determinacy of meaning. Situational entanglement also provides disaster managers guidance to assess the value of different actors and the success and failure of technology during a response.

In the following section, I first review the relevant literature on emergency and disaster management that usefully examines emergence as an *empirical* phenomenon, affecting and affected by the use of technology. However, I argue that this research provides limited guidance for understanding the relationship between technology and emergence as a *conceptual* phenomenon. To overcome these conceptual limitations, I draw on emergent approaches in organizational technology studies (Leonardi, 2007; Orlikowski, 2007, 2010). Next, I articulate the situational boundary-making approach and offer a set of research questions that guide the inquiry and analysis of qualitative data gathered for this study. After explaining the methods of data gathering and analysis, I present the results of the analysis. Finally, I conclude with a discussion on the theoretical and practical implications for organizational technology scholars and disaster management practitioners.

Technology As a Coordination Mechanism in Disaster Management

Disasters often trigger emergent social behaviors and new organizational forms. Specifically, emergence is conceptualized in disaster research as a "convergence" of individuals and groups at the scene of a disaster (Drabek & McEntire, 2003). Stallings and Quarantelli (1985) found that during emergence, organizations and individuals take on new tasks and relationships that exist outside of normal, routine behavior. Quarantelli (1966, 1996) developed a typology of organizations in disaster response that identified organizational types by tasks and structures. Emergent organizations are those with both new structures and nonregular tasks.

Emergent organizations must share resources in unfamiliar ways that cross jurisdictional boundaries, and because of intense pressures to perform rapidly, problems often occur with inadequate interorganizational coordination and communication. Scholars and practitioners of disaster and emergency management argue that new and emerging technologies have the potential to improve the management of emergence in crisis (Alexander, 1997; Rodriguez, Wachtendorf, & Russell, 2004; Stephenson & Anderson, 1997). As a coordinating mechanism in interorganizational networks, technology enables communication and sharing of information more effectively (for an exception, see Quarantelli, 1997).

The nature of technology as a coordinating mechanism is often depicted in one of two forms in this literature: technology as an "agent of change" or as an "object of change." In the first form, technologies act as mechanisms that *change* forms of organizations in disaster response toward improved coordination. This perspective isolates technology as an important component in (re)configuring organizational forms because of information and communication technologies' (ICTs) so-called transformative capabilities. In an examination of three case studies of disaster management, Riley and Meadows (1997) found that a flexible database system could potentially facilitate rapid, accurate information sharing between organizations. Gant (1996) studied how ICTs shaped disaster networks and concluded that ICTs may change networks' level of centralization. Implicitly, technology becomes the mechanism that may order the messiness of emergent disaster-relief efforts. This perspective tends to tilt toward technology to explain both stability and change (Jackson, Poole, & Kuhn, 2002) and draws on received views of technology as stable, fixed, and discrete, assuming the unproblematic nature of technical artifacts (Orlikowski & Iacono, 2001).

In the second form, technology is depicted as an object of change. Research that foregrounds the unique social and cultural practices of disaster response

organizations focuses on how to *align* technology implementation with organizational culture and structures. An alignment perspective suggests that it is possible and desirable to "match" affordances of technologies with existing or desired organizational practices or states. Banipal (2006) argued that careful integration of communication and information systems within disaster response organizations would develop more robust emergency communication systems. Comfort, Sungu, Johnson, and Dunn (2001) theorized how certain technological affordances of tools to support decision-making were better suited to match the desired self-organizing state of organizational systems. These approaches tend to tilt toward the social to explain the variability and stability of technology use (Jackson et al., 2002). As a result, technology may be reduced to affordances, as a functional tool designed to serve organizational processes.

Both agent of change and object of change approaches create limitations for understanding emergent organizational dynamics. Despite the promises of technology to facilitate interorganizational emergency response, disaster response organizations often use ICTs in an ad hoc fashion (Gant, 1996). Thus, technology as an "agent of change" to manage emergent behavior may not fully account for the effects that often unpredictable emergent behavior may have on technology use. In addition, technology as an "object of change" that seeks to align technological affordances with organizational cultures and structures may oversimplify the function of technology in emergent disaster situations.

In summary, disaster and emergency management research usefully directs our attention to emergence as an *empirical* phenomenon affecting and affected by the use of technology. However, this research provides less guidance for understanding the relationship between technology and emergence as a *conceptual* phenomenon. To overcome the limitations of "agent of change" and "object of change" approaches to technology, I employ a situational boundary-making approach to study the emergence of organization and technology in disaster response. In the following section, I introduce the conceptual basis of this approach by situating it alongside related approaches in organizational technology studies.

Approaches to Organization and Technology as Emergent

Organizational scholars have embraced an emergent conceptual focus for explaining the relationship between organization and technology (Leonardi, 2007; Leonardi & Barley, 2008; Orlikowski, 2007, 2010). Rather than approaching technology as a coordination mechanism between organizations,

an emergent conceptual focus is used to examine how social structures and technologies are enacted and reciprocally intertwined in organizational practices. The basic assumptions of emergent conceptual approaches are that (a) neither technology nor organization is foregrounded a priori, (b) human and technological agencies temporally emerge, and (c) technological and organizational changes are mutually constitutive.

To define these emergent approaches, it is useful to compare them with existing structurational approaches in organizational technology studies (Giddens, 1986). Emergent approaches differ in two main ways from earlier structurational approaches (Orlikowski, 1992; Poole & Desanctis, 1990). First, instead of structures embedded in the technologies themselves, early emergent approaches showed how structures of technology were *enacted* through recurrent interaction (Orlikowski, 2000). "Every engagement with a technology is temporally and contextually provisional and any structure is always an ongoing accomplishment that results from everyday practices" (Orlikowski, 2000, p. 412). Second, instead of locating agency solely within the human actor, more recent emergent approaches have theorized a *relational agency* between technologies and human actors (Leonardi, 2007; Orlikowski, 2007, 2010).[2]

However, exactly how technological and human actors interrelate differs across this emerging literature. On the one hand, scholars have adopted an analytic focus on the *reciprocal interaction* between human and technological actors (Leonardi, 2007; Pickering, 1995). This approach assumes that organizational practice is goal-oriented, recursive, and that the use of technology has a patterned nature. This patterned use of technology then shapes social arrangements and organizational structures over time. Leonardi (2007) examined the reciprocal interaction between humans and technologies by isolating how material features of technology, which become affordances in use, shaped the social structure of organizations. In a study of information technology (IT) use, he found that information enabled by IT led to changes in informal advice networks in an organization. Through the activation of the technology's material affordances in practice, the organization's social structure was transformed from its previously rigid hierarchical form (Leonardi, 2007).

On the other hand, scholars have also adopted an analytic focus on the *constitutive entanglement* of human and technological actors (Barad, 2007; Orlikowski, 2007, 2010). This approach assumes that organizational practices consist of an inextricable relationship between the social and material, such that a priori demarcation of technologies from humans is not necessary. Orlikowski (2010) argued that human and technological actors are always relational, performed in "sociomaterial" assemblages. She argued that the

entanglement of different sociomaterial agencies always makes some organizational practices and knowledge more salient than others. As such, technologies are parts of sociomaterial assemblages that enact boundaries to make some actors more meaningful than others.

In summary, recent approaches in organizational technology studies theorize emergence as relationships enacted in organizational practices through different forms of shared agency. I now combine the conceptual insights of these scholars with the empirical insights of disaster and emergency management research. In the next section, I articulate this combination as the situational boundary-making approach, which I then use to examine the emergence of technology and organization in disaster response.

The Situational Boundary-Making Approach

The situational boundary-making approach has two aims: (1) to apply an emergent conceptual focus to study organizational and technological emergence in disaster response and (2) to use the empirical context of emergence in disaster response to inform and extend existing emergent conceptual approaches. To this end, the approach specifies two important aspects of emergence for the analyst's attention: the *situation* as the focal point for selecting and discerning which actors matter in emergence and attention to shared agency as a form of *boundary-making*.

First, based on disaster response research, we know that uses of technology in emergent organizations ad hoc (Gant, 1996). In addition, what form an organization takes in this context cannot be taken for granted (Drabek & McEntire, 2003; Quarantelli, 1996). However, reciprocal interaction and constitutive entanglement approaches to emergence have so far either examined relatively routine organizational uses of technology or the use of technology in relatively well-established organizations or organizational practices. However, to study emergence in disaster response, an approach is needed that does not take the stability of organization or organizational practices for granted. To this end, I articulate the *situation* as the focal point for selecting and discerning which agencies matter in emergence. This focal point starts with a grounded approach wherein changing situational circumstances are significant to conceptualizing emergence. This focus embraces the unpredictability of disaster response, where organizational actors and technologies are directed toward addressing often unknown and quickly evolving problems.

Second, we know based on reciprocal interaction and constitutive entanglement approaches that agency is relational, shared between different actors.

Differences in theorizing this relationality are important for defining which aspects of technology and organization the analyst chooses to highlight. Reciprocal interaction approaches focus on technological affordances and recurrent practices, while constitutive entanglement approaches focus on sociomaterial practices. However, in order to study emergence with a situational focal point, I theorize relationships between agencies specifically as *boundary-making*.[3] The analyst starts with the assumption that for every meaningful and determinant agency, there is always an agency that is made indeterminate, or part of the "constitutive outside" to what is made meaningful (Barad, 2007). Boundary-making embraces the variable agency of emergent approaches but focuses the analyst on one particular dynamic of relationality: inclusion and exclusion.

In summary, the situational boundary-making approach brings together conceptual approaches on emergence in organizational technology studies with empirical studies of emergence in disaster research to inform one another. In particular, elements of the situation become a primary focal point for selecting and discerning which agencies matter. Furthermore, the relationship between actors is a process of boundary-making, wherein some actors are always excluded to the inclusion of others. I employed this approach to study the emergence of technology and organization in disaster response, asking the following research questions:

RQ1: How does situational boundary-making occur in emergent disaster response efforts?
RQ2: How do situational boundary-making practices shape the design and use of technology?

Next, I describe the research context of this study and provide details on the research site and methods employed to answer the research questions.

Research Context

Hurricane Katrina was one of the largest and deadliest natural disasters in United States history (Knabb, Rhome, & Brown, 2005). The impact of Katrina reached from Florida to Louisiana, causing damage in all of the Gulf Coast states. In New Orleans, the breach of levees submerged parts of the city, requiring an emergency evacuation of thousands of residents. Some 137,000 of these residents evacuated to the southern state that is the focus of this study. In particular, the City of Jackson opened a large shelter for a period of

3 weeks and provided food and clothing to almost 4,000 Katrina evacuees through donations and efforts of almost 6,000 volunteers (Federal Emergency Management Agency, 2006).

Opening this shelter required the cooperative efforts of multiple organizations and volunteers. The local Office of Homeland Security and Emergency Management (HSEM) officially "activated" the shelter on the Friday after Katrina made landfall. Volunteer organizations prepared the shelter for evacuees' arrival by securing food, water, cots, and other services at the shelter such as showers and clothing. First responders were on hand to perform medical triage and ensure security at the shelter. See the appendix for a description of the main parties involved in the response at this shelter.

While food and cots were being secured, volunteers also set up several technologies at the shelter. Computers and online technologies were used for two main functions at the shelter. First, volunteers set up a bank of 20 donated computers to handle the "intake" of evacuees. To identify evacuees and improve security at the shelter, an intake database was designed by these volunteers to receive and record the information of evacuees who stayed at the shelter. Second, volunteers also set up a bank of "public" computers exclusively for evacuees to use to search for missing loved ones using an online people-finding site, also designed by volunteers.

The technology volunteers and the technologies they designed and deployed at the shelter are the focus of this study. The parties involved in technology deployment and design at the shelter included the city's Department of Communications and Technology Management (CTM), the large nonprofit organization Health Plus, local university technology developers, local technology vendors, and individual technology volunteers. These different organizations and groups converged at the shelter to form an emergent organization (Drabek & McEntire, 2003). They had little to no prior experience working together, and the technology applications they implemented did not exist the day before the response. Rather, both the working relationships between volunteers and the technology applications they implemented were designed during the first days of the response.

Method

Interviews

Through in-depth interviewing, I gathered descriptions and interpretations about volunteer practices during and after the Hurricane Katrina response. I contacted 28 technology volunteers, of which 22 agreed to be interviewed.

Five were CTM employees for the city, three were volunteers representing large technology firms, and 14 were individual technology volunteers with experience working in the high-tech industry in software development, Website design, database engineering, and IT security. With the exception of only one person, all of my participants volunteered during the response to Hurricane Katrina. Their experience of volunteering as part of an emergent organization at the shelter was desirable for my aims to study the emergence of organization and technology in disaster response. Eight of the participants were female and 14 were male.

The style of qualitative interviewing I employed can be characterized as a conversation with a purpose. These interviews ranged in length from 30 minutes to 2 hours. The majority of the interviews were conducted face-to-face at the individual's place of work or at a public location such as a coffee shop or restaurant. When it was not possible to meet in person, I conducted the interviews over the telephone. I used a basic guide in all of the interviews, although most conversations expanded in a number of directions from the initial interview questions.

The questions asked participants to describe their practices as volunteers in response to Hurricane Katrina and to reflect on their volunteering experiences. They were also asked how the design and use of technology was conducted among the various actors at the shelter. Broad and open-ended questions stimulated discussion on these issues without limiting the range of appropriate topics. Tape-recorded conversations were transcribed for analysis, resulting in approximately 230 single-spaced, typed pages. In addition, I took detailed notes to accompany the recorded interviews.

Participant Observation

I also observed four post-response meetings. These meetings took place over a 4-month span in the spring of 2006. The purpose of the meetings was for technology volunteers to discuss lessons learned from the Katrina response and develop strategies for future technology deployment. These meetings allowed me to observe the "talk" of organizational members. I gained insight into collective sensemaking processes, which are central to how organizational members understand the reality of organizational life (Weick, 1995). Throughout this process, I took scratch notes and in some cases headnotes, which I immediately typed into field notes (Lindlof & Taylor, 2002). These activities resulted in 10 hours of participant observation.

Listserv Archives

I was also given access to an e-mail listserv that was created during the Katrina response to coordinate the volunteers at the shelter. This listserv was publicly available online, but I was invited to analyze this data by the listserv host, whom I also interviewed for this study. Messages on the listserv spanned from September 2005 to July 2006, with a total of 244 volunteers subscribed to the list at its peak usage from various volunteer groups and organizations. To learn more about volunteer practices during the disaster response, I analyzed only the messages from September 2005 posted during the actual response at the shelter. These data consisted of 220 individual messages posted over the course of 20 days by 70 individual authors.

I compared and triangulated the three types of data used: interview transcripts, field notes from participant observations, and messages from the listserv. Cross-referencing each of these three sources increases the validity of the study (Taylor & Trujillo, 2001).

Data Analysis

I employed a version of the constant comparative method of qualitative research (Glaser & Strauss, 1967; Strauss & Corbin, 1998). Using the computer software N6, I first coded the data, engaging in a process of open coding, which is the initial, unrestricted coding of data (Strauss, 1987). Codes serve to mark meaningful data and begin the process of building categories (Lindlof & Taylor, 2002). This form of unrestricted coding was used to identify emergent situational elements, actors, and technologies that were important at the shelter. This open-coding process resulted in a total of 122 codes.

Codes that identified situational elements captured the salient aspects of the situation. For example, codes such as "lack of leadership" and "lack of systems" identified important situational challenges that emerged from the data. Codes that identified important actors at the shelter captured the qualities of actors and their practices during the response. For example, codes such as "proactive" versus "reactive" identified important differences in the practices of actors that emerged from the data. Finally, codes that identified important technologies at the shelter captured the aspects of technology design and use. For example, codes such as "problem solving" and "fixing failure" identified design and uses of technology that emerged from the data.

Next, I arranged the codes, when applicable, into a timeline. This timeline was used to identify significant events that occurred during the response and

which situational elements, actors, and technologies were important to those events. For example, I used the timeline to identify the first hours of the response as a significant event for volunteer practices at the shelter, during which technology's main role was responsiveness to immediate situational demands. The timeline showed how technology during this time period was distinct *in time* from the same technology in a subsequent time period. This step of analysis was used to develop the situational focus of the situational boundary-making approach.

Finally, I interpreted and arranged the codes into broader categories. This process of integration produces deeper meanings by drawing out relationships between codes (Lindlof & Taylor, 2002). Specifically, the process of integration was used to develop an understanding of the relationships between situational elements, actors, and technologies. For example, I used integration to identify a relationship between the responsiveness of technology and a type of responsive volunteer practice at the shelter that occurred in the first hours of the response. I categorized these codes together under a representative category "responsive practices under extraordinary situational demands."

However, integration also allowed me to notice which codes were *not* associated with each other. I used this to identify excluded elements and develop an interpretation about the role of exclusion in the process of emergence. For example, I identified the exclusion of reactive volunteer practices at the shelter that occurred during the first hours of the response. I categorized these codes together into a representative category named "reactive practices under extraordinary situational demands." This step was used to develop the boundary-making focus of the situational boundary-making approach. Next, I present the conceptual scheme resulting from this analysis called situational entanglement.

Situational Entanglement

City of Jackson volunteers converged within hours of Hurricane Katrina to deploy technology at the shelter, forming an emergent organization. This analysis will show how organizational and technological emergence in disaster response occurred through *situational entanglements*, consisting of three main elements: a salient moment in time, key actors, and boundary-making practices. The entanglement process will show how key actors' responses to salient moments in time enacted both distinction and dependency between organizational and technological actors. These boundary-making practices defined the situation at the shelter, resulting in an emergent organization

marked by a divide between actors. In the next section, I present the situational entanglement as it occurred at the City of Jackson shelter.

The City of Jackson Situational Entanglement

Two salient moments in time comprised the focal points for City of Jackson volunteers at the shelter. The first salient moment occurred during the initial hours of the response when volunteers faced extraordinary situational demands. During this time, volunteers experienced significant pressure and uncertainty at the shelter. The second salient moment occurred around the second day of the response, when volunteers faced compounded situational demands. During this time, volunteers experienced the failure of the technologies they had initially designed.

These two salient moments in time triggered key actors' boundary-making practices. First, I found that under extraordinary situational demands, volunteers responded in distinctly different ways. Some volunteers responded quickly to situational demands with the design and deployment of responsive technologies while other volunteers waited to take action. Second, I found that when the technology later failed, and compounded the situational demands, the investment in responsive technologies increased as additional volunteers and technologies were enrolled to fix the failed technology.

These boundary-making practices enacted distinction and dependency between key actors. First, an early distinction was enacted between volunteers and technologies at the shelter that were responsive versus volunteers and technologies that were reactive to the initial extraordinary demands. Second, after responding to the compounded situational demands created by the failure of responsive technology, a dependency was enacted between volunteers and responsive technologies at the shelter.

The enactment of distinction and dependency between organizational and technological actors defined the situation at the shelter, resulting in a divided organization. On the one hand, responsive volunteers and technologies coemerged to gain control of the situation at the shelter, becoming defining actors. On the other hand, reactive volunteers became exterior to the developing situation at the shelter and soon became isolated actors. See Figure 1 for an illustration of the process of situational entanglement at the City of Jackson shelter.

In the next section, I present two illustrations of the City of Jackson situational entanglement. The first illustration shows the dynamics of situational entanglement as they occurred during the development of an evacuee intake technology at the shelter. The second illustration shows the same dynamics, but as they occurred through the development of online tools for evacuees to

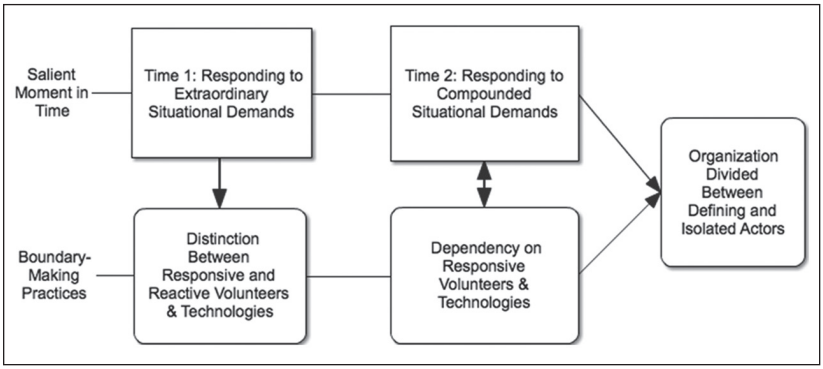

Figure 1. The process of situational entanglement at the City of Jackson shelter.

search for missing loved ones. See Table 1 for a breakdown of the elements of situational entanglement for each illustration.

Illustration One: Evacuee Intake

In the first uncertain hours of the response, volunteers from the City of Jackson, Health Plus, and other technology volunteers struggled to develop a system for keeping a record of evacuee information upon their arrival at the shelter. Though most volunteers at the shelter were eager to take action, no single person or organization was stepping into place as a leader at the shelter. Tanya, a volunteer that worked at the intake table for the city, recalled how uncertain the situation was during the first hours of that Friday night: "I think one of the biggest things was no one could figure out who was in charge. It was just chaos constantly." Furthermore, none of the organizations at the shelter had a technology for evacuee intake. Dana, a technology volunteer working at the intake tables, explained her surprise that Health Plus did not already have a system in place. "This is a huge, old, national organization. You would think they would have some technical skills somewhere. They don't. And it just surprised the heck out of everybody." There was no intake system at the shelter and thousands of evacuees were arriving in need of assistance.

Under these extraordinary situational circumstances, volunteers responded in distinctly different ways. Initially, most volunteers assumed that Health Plus would provide the leadership to direct the evacuee intake at the shelter. However, rather than direction, most volunteers recalled how Health Plus reacted to the situation with paralyzing inaction. Gary, a technology volunteer

Table 1. Elements of Situational Entanglement by Illustration

Elements of entanglement	Illustration one	Illustration two
First salient moment in time		
Extraordinary situational demands	Leadership vacuum at shelter intake. Absence of an intake system.	Evacuees lost loved ones. Absence of a system to connect missing loved ones.
Practices enacting distinction of reactive volunteers	Health Plus was paralyzed with inaction.	City of Jackson and Health Plus prohibited connections. Health Plus took delayed action.
Practices enacting distinction of responsive volunteers	City of Jackson and technology volunteers quickly designed a custom database.	Technology volunteers quickly set up public computers and online tools.
Second salient moment in time		
Compounded situational demands	Physical presence and record in the database no longer corresponded. Crashing database.	Proliferation of people-finding posts/forums overwhelmed evacuees.
Practices enacting dependency on responsive technologies	Fixing the failed database increased volunteers' investment in the system.	Fixing the failed online tools increased evacuees' reliance on the system.
Resulting divided emergent organization		
Defining actors	City of Jackson technology volunteers and the database co-emerged to gain control of the situation, acting as a leader of intake at the shelter.	Technology volunteers and the centralized online tools co-emerged to provide evacuees control of the situation.
Isolated actors	Health Plus was sidelined from the efforts of the City of Jackson and technology volunteers.	Health Plus did not recognize the need technology volunteers were meeting.

working on evacuee intake, described his experience of Health Plus volunteers in the first hours of the response: "I remember Dana and I running around trying to find the person responsible and the answer from Health Plus was, 'We'll be able to tell you who that person is in about four hours or so.'" Dana described the initial "lack of action" from Health Plus as "criminal," while Tanya elaborated that "it was a mess—they [Health Plus] were just a complete nightmare."

However, some volunteers were responsive to the extraordinary demands in the first few hours of the response. Volunteers from the City of Jackson and other technology volunteers responded to the extraordinary situational demands by designing a new intake database on the spot in the shelter. Peg, a city volunteer, described their practices: "We grabbed TVs, printers, fax machines, and some laptops. We just grabbed 50 of the computers from our training room so that acted as our [shelter's] first supply." Dana recalled the intake system they had set up within hours: "They had 20 computers set up. There was a volunteer, a computer, and an evacuee sitting in front of you and you were taking their information. It had lots of questions in this database, and for two days, 24 hours a day, people were coming to the shelter that needed to be put in this database." Gary shared his reaction to the swiftness of responsive volunteers. "That Friday night, the fact that they had a system up and running was miraculous."

However, by Saturday, the newly designed intake database had already begun to fail as circumstances at the shelter began to change. Evacuees' physical presence in the shelter no longer correlated with their records in the database. Tanya recalled the circumstances of the database failure:

> First, we started giving them [evacuees] wristbands with numbers, and we thought, "Oh this is a great idea." You have a number [from the database] and you associated the number with their [evacuees'] cot, so we knew where they were physically located on the floor. The problem was they'd take showers and they'd fall off. Then we would give them another number so we would have seven different entries in the database for Joe Smith, and we could never keep track of which was the correct number.

By Saturday morning, volunteers on the volunteer message forum had declared the database a "toxic waste dump" and volunteers reported the database was "crashing" regularly.

Volunteers at intake were now faced with responding to a new demand created by the failed technology. Ironically, the failure of the database did not

undermine the efforts of the City of Jackson and the technology volunteers. Instead, volunteers' investment in fixing the system only increased their dependency on the system. In order to fix the failed technology, new volunteers were specifically recruited to develop a system to work around the failed database and then merge the new data back into the repaired system. Fifty volunteers were tasked with collecting and correcting the evacuee data manually using Excel spreadsheets. Dana recalled the grueling process: "They had a special little area for people to take the Excel spreadsheets, which were so long, and they had them all taped together. People took these Excel spreadsheets and had to re-enter them all by hand." Volunteers invested hundreds of hours into the recovery of the system and transfer of the evacuee data back into the repaired database.

As volunteers became more invested in fixing the intake system, the City of Jackson volunteers, with the database, soon gained control, leading the intake at the shelter. Gary, a technology volunteer reflected on this moment: "The fact that the city was able to build a database, even if it was kind of jerry-rigged, they did the job they were able to do, and the fact that they were able to get it up and running so quickly was fabulous."

However, once responsive volunteers and technologies had taken control of the intake situation at the shelter, Health Plus, who had already reacted to the situation with inaction, had become completely sidelined from any further involvement with the efforts of the City of Jackson and technology volunteers. Dana talked about her recognition of this separation between the volunteers' efforts:

> What we thought was happening, was that this information [in the database] was getting into the big Health Plus or FEMA database in the sky or something. By the second day, it started dawning on me that I should ask, you know. "What can we tell people? Where did this information go? Who knows at a federal level where's it going? Oh, it's not going anywhere; it's the city's information. It's the city's database." And I thought, "So how does anybody know who's here at the federal level," and it's like, "Well, they don't."

By the second day of the response, Health Plus volunteers were largely uninvolved in the design of evacuee intake.

Illustration Two: Online People-Finding

Evacuees were brought to the City of Jackson shelter by the busloads from New Orleans and surrounding areas. In the process of evacuation, many

families were separated from each other as they were loaded onto different buses or taken to shelters at different times. A technology vendor, Brad, described how uncertain the situation was for evacuees: "There were a lot of people who were lost. You know, 'Where is mother? She got on a bus 3 hours ago. Where did it go? I have no idea.'" Many evacuees had no way to communicate with loved ones they had been separated from and volunteers were not sure how to reconnect people. Rachel, a technology volunteer explained, "In Katrina, they did not know where a lot of people were. Loved ones were calling and no one could track them down or tell them if they were alive, if they were well, or even if they were in [the city]."

Under these extraordinary situational circumstances, volunteers responded in distinctly different ways. Initially, both Health Plus and the City of Jackson volunteers had actually created barriers to evacuees making connections. Even though the City of Jackson volunteers had gathered evacuee information during shelter intake, that system was not made accessible for people finding. Furthermore, Health Plus was unwilling to confirm the identity of evacuees at the shelter over the phone. Gary, a technology volunteer, explained this problem on the volunteer listserve: "One of the Health Plus folks told me this evening that when folks call into the Center to find loved ones, for privacy/safety reasons they can't say whether a person is in the shelter or not." Once the problem became apparent to Health Plus, they started an initiative to organize the location information of evacuees, but could not complete it fast enough. Danny, a technology volunteer explained his interactions with the new Health Plus system: "Health Plus kept sending mixed signals. Everyone would be told to stop working and put their data into the official site, except that it is not up and you waited another day and nothing happens."

However, some volunteers were responsive to the extraordinary demands in the first few hours of the response. Technology volunteers began setting up "public computers" at the shelter that evacuees could use to e-mail and search the Internet. Technology volunteers knew that people outside of the shelter, all over the country, were posting inquiries and whereabouts of evacuees online. Online postings, forums, and e-mails were quickly designed and deployed to meet the extraordinary situational demand. Kim, a technology volunteer, explained, "There were Web sites nationwide put up. They [evacuees] can list themselves as being here [at the shelter], and people could actually search to see if they could find them." Jan, another technology volunteer, recalled the initial success of the technologies, "I think it was a real eye opener for people that they could use technology to find family members."

However, after the first hours, the online tools began to fail. A proliferation of web postings and "people finding" websites overwhelmed evacuees searching for loved ones online. Danny, a technology volunteer, explained

this problem: "That's not a very useful thing to do if you're looking for your uncle; you have to know where all 20 sites are and search each one of them, and if you happen to miss the one that your uncle is listed on, you're screwed." Because of the proliferation of sites, a new problem arose: How, in the sea of information, could someone locate the actual presence of the evacuee? A technology volunteer, Jack, shared this story about the problems caused by the technologies on the volunteer listserve:

> The mish-mash and mixups of multiple [people-finding] databases being used are taking a toll. Poor Randy, we sent him to San Anapolis yesterday to bring his wife back from the shelter. She was gone when he got there. Nobody knew where. This morning she shows up on the Katrina Locater List, but not on the Family Link List. I really feel for him.

Volunteers were now faced with responding to a new demand to fix the failed technology.

Ironically, the failure of the online tools did not undermine the efforts of the technology volunteers. Instead, volunteers began investing more effort into fixing the online tools, which only increased their dependency on the technology. Technology volunteers began directing the efforts of additional volunteers and technologies toward centralizing the online people-finding information. Danny described how, within days, they had organized thousands of online volunteers to create a solution:

> Over the weekend we had 3,000 volunteers going over things like Craig's list and hand entering all the posts from Craig's list as unstructured data. And we had hackers going through all the structured data converting that into the people-finder interchange format that we developed over the holiday weekend.

After the interchange of the data into one single format had been completed, technology volunteers and online people-finding sites were able to help evacuees find missing loved ones. Evacuees became increasingly reliant on these technologies to locate and communicate with their loved ones. Dana described a technology volunteer making a successful connection: "Valarie helped this older man set up his e-mail address and search the sites. He came back the next day and he had forgotten how to check it [e-mail] and when she helped him check it he had three e-mails from family and friends who were looking for him!" As volunteers and evacuees became more reliant on the system, the technology volunteers and the online technologies co-emerged to provide evacuees a sense of control at the shelter.

However, once technology volunteers and online tools began to connect evacuees with missing loved ones at the shelter, Health Plus, who had already reacted to the situation with prohibitive or delayed responses, seemed unable to understand the efforts of the thousands of technology volunteers who created the people-finding site. Technology volunteers recalled their failed efforts to seek collaboration from Health Plus. Danny explained,

> My impression right now is that they [Health Plus] don't necessarily understand the concept of what we did, massively paralleling an all-volunteer, all-Internet-based kind of immediate response. They don't quite get it, and therefore it is very hard for us to be in a position to coordinate it. Which is what we needed badly—we needed that coordination from some of the official disaster-relief folks, the Health Plus or FEMA or somebody else.

In summary, these two illustrations showed how the dynamics of situational entanglement occurred at the City of Jackson shelter. In response to extraordinary situational demands, volunteers became distinct as either responsive or reactive through their practices. Reactive volunteers responded to the situation with inaction or delay, while responsive volunteers responded to extraordinary situational demands through the design of responsive technologies. However, responsive technologies eventually failed, creating new, compounded situational demands. As volunteers invested more effort into fixing the failed technology, they became more dependent on these technologies. After the increased investment, responsive volunteers and technologies co-emerged to gain control over the situation and, as a result, to have a defining role at the shelter. However, reactive volunteers did not respond quickly enough to situational demands and, after situational demands compounded, became isolated from the efforts of defining actors at the shelter. In the next section, I discuss the implications of situational entanglement for organizational technology theory and disaster response practice.

Discussion

The purpose of this study was to articulate and employ a situational boundary-making approach to examine the emergence of organization and technology in disaster response. Using this approach to study the emergent organization at the City of Jackson shelter resulted in an analysis of organizational and technological emergence as *situational entanglements*, consisting of three main elements: a salient moment in time, key actors, and boundary-making practices. The entanglement process showed how key actors' responses to salient

moments in time enacted both distinction and dependency between organizational and technological actors. These boundary-making practices defined the situation at the shelter, resulting in a divided organization.

In this section, I discuss the implications of situational entanglement for theory and practice. First, I discuss the implications of situational entanglement for extending existing theories of organizational and technological emergence. Situational entanglement extends existing emergent theoretical approaches by showing how organization and technology are situationally organized and how emergence occurs through the (in)determinacy of meaning. Next, I discuss the implications of situational entanglement for disaster response practice. Situational entanglement provides disaster managers guidance to assess the value of different actors and the success and failure of technology during a response.

Implications for Theories of Organizational and Technological Emergence

Theory on the emergence of organization and technology have difficulties accounting for the unpredictability of disaster response and crisis situations. These difficulties stem, in part, from assumptions about what constitutes an organization and a technology. Scholars have conceptualized organizations as stable entities or as routine organizational practices. Scholars have conceptualized technologies as parts of enduring sociomaterial assemblages (Orlikowski, 2007) or as technological affordances connected to stable features of a technology (Leonardi, 2007).

The situational boundary-making approach offered a different set of assumptions about organization and technology. Namely, the situational focus connected organizational practices and technologies to *salient moments in time*. The City of Jackson situational entanglement showed how organizational practices occurred as responsiveness, or lack thereof, to initial extraordinary situational demands and later compounded situational demands. Technologies were situational agencies, constituting responsive practices in the initial extraordinary demands, but later creating the compounded situational demand.

The situational focus extends theory on emergence in organizational technology studies by showing how organization and technology are *situationally organized*, occurring in relation to the moment (Schatzki, 2006). Situationally organized practice is significant because it provides a logic for a more fluid conceptualization of both organization and technology. The implication is that organizations are conceptualized as sets of continuously changing relationships between actors, such that loosely affiliated relationships

constitute a proper analytic focus rather than an organizational entity or set of routine practices. Technologies are conceptualized as situational agencies, such that the response of technology in the moment constitutes a proper analytic focus rather than a technological affordance (Leonardi, 2007) or sociomaterial assemblage (Orlikowski, 2007). This approach is important for organizational technology scholars as emerging technologies and new forms of organization become increasingly prominent in organizational life.

Theory on the emergence of organization and technology also have difficulties accounting for the unpredictability of disaster response and crisis situations because of assumptions about *how* emergence occurs. Emergence occurs through organizational members patterned uses of technology over time, which is theorized as recurrence in practice (Leonardi, 2007), or as the sedimentation of organizational meaning into a technological apparatus, which is theorized as sociomaterial practice (Orlikowski, 2007). Both approaches assume a stability of organizational practice that cannot be taken for granted in disaster response and crisis situations.

The situational boundary-making approach offered a different assumption for how emergence occurred. Namely, the boundary-making focus assumed emergence occurred through the inclusion and exclusion of organizational and technological actors. The City of Jackson situational entanglement showed how reactive volunteers became distinct from responsive volunteers early in the response. Later in the response, as volunteers became more dependent on fixing responsive technologies, these technologies and responsive volunteers co-emerged to gain control of the situation at the shelter. The result was an emergent organization marked by a divide between defining actors and isolated actors.

The boundary-making focus extends existing theory on emergence in organizational technology studies by showing how emergence occurs through the *(in)determinacy of meaning*. In other words, inclusion and determinacy of meaning are always accompanied by exclusion and indeterminancy of meaning (Barad, 2007). Emergence through the (in)determinancy of meaning is significant because it provides a logic for conceptualizing emergence as a process characterized by both organization and disorganization. The implication is that rather than assuming meaning is inherent to an organizational or technological actor, or resulting from a single purposeful act, meanings are the making of boundaries between actors through response practices in time. This approach is important for organizational technology scholars to understand the subtle dynamics of power and control that accompany an increasing dependency on technology in organizational life.

Implications for Disaster Response Practice

Approaches to organizational emergence in disaster and emergency management classified emergent organizations as having both new structures and nonregular tasks (Quarantelli, 1966, 1996). A situational boundary-making approach expands this definition by demonstrating *how* emergent organizations take shape. The analysis of situational entanglement at the City of Jackson shelter showed that three specific elements were important to explaining the emergent organization: salient moments in time, key actors, and boundary-making practices. As a result, the analysis showed how different actors and technologies emerged in relationship to different moments in time. Ironically, Health Plus, the organization with the most established experience in disaster response scenarios, was the reactive actor, and later the most isolated actor at the shelter. However, actors and technologies that were responsive to the situation were those that were not particularly organized before the response.

Expanding the definition of emergent organization to include the process of how multiple elements relate has implications for the management of emergent organizational dynamics. This approach suggests that it is important for disaster managers to assess continuously the value of different actors during a response, rather than presuming the capacity of an organization or actor to respond. Ironically, official organizational actors may be unorganized in the situation, and so-called unorganized actors may be best equipped to organize in response to the changing situation. Following this expanded approach to organizational emergence, disaster managers might ask, "How should we assess the value of organizational and nonorganizational actors in light of changing situational circumstances?"

To manage emergent organizational dynamics in disaster response, technology has been depicted as either an "agent of change" or an "object of change." A situational boundary-making approach overcomes the limitations of these approaches by showing how technology is a situational actor. As a situational actor, technology acts both as a response to a situation and as a producer of situational change, rather than a coordinating mechanism between organizational actors. The analysis of situational entanglement at the City of Jackson shelter showed how the same technology became distinctly different at different points in time. In the initial response to extraordinary demands, both the evacuee intake database and the people-finding sites constituted an important part of the response to the situational problems that were faced at that moment. However, within a short period of time, both technologies shifted. As the database and the finding sites began to fail, they became part of the situational problem, rather than part of the solution.

Approaching technology as a situational actor has implications for how disaster managers might assess technology success and failure in disaster response. This approach suggests that the success of technology should be dependent on how it takes shape within sets of changing relationships over different points in time. Because situational circumstances are constantly changing, disaster managers might expect technology failure as a normal part of disaster response practice and, as a result, prepare to respond to the demand that failed technology creates. Disaster response managers might ask, "What will inevitably occur due to failed technology in crisis situations, and what kind of response is needed to address these compounded situational demands?"

Conclusion

Disaster response and crisis situations challenge our understandings of organizational and technological emergence. This study has offered one way to address this challenge through the situational boundary-making approach, which conceptualizes emergent organization–technology relationships as situational entanglements. I have shown how situational entanglement extends emergent theoretical approaches by showing how organization and technology are situationally organized and how emergence occurs through the (in) determinacy of meaning. I have also shown that situational entanglement has implications for disaster managers assessment of the value of different actors and the success and failure of technology during a response.

This study has some limitations. First, this analysis is neither representative of the entire response that took place at this shelter nor is it necessarily generalizable to other disaster response scenarios. Because this analysis reflected data collected from an emergent organization at a single shelter, it may exclude other important organizations and actors. Second, this analysis was selective in the organizational dynamics on which it focused. Because this analysis foregrounds practices and actors in the moment, it may exclude other important organizational dynamics such as the history or interests of organizational actors.

Despite these limitations, the implications of this study show promise for organizational technology and disaster response scholars who are grappling to understand organization and technology under volatile situational circumstances. In an increasingly globalized world, organizational actors have more dense connections, act under increased time pressure, and increasingly rely on technology (Fulk & DeSanctis, 1999). Future studies can utilize a situational boundary-making approach to theorize and understand the emergence of organization and technology under such uncertain conditions.

Appendix

Main Parties at Shelter During Hurricane Katrina Response

Organization/group	Description
National organizations	
Health Plus	A volunteer-led organization guided by a congressional charter to provide relief to victims of disaster.
Federal Emergency Management Agency (FEMA)	National organization charged with supporting citizens and first responders to ensure the capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.
City offices	
Office of Homeland Security and Emergency Management (HSEM)	Coordinates the citywide response to large-scale emergencies and disasters. This includes planning and activities for preparedness, response, and recovery phases of a disaster.
City Manager's Office	Manages all of the city's services. Also handles city planning and development. Many city departments were involved in the response.
First responders	Police, fire, and emergency services that attend to security and needs of evacuees during a response.
Technology-specific volunteers	
Communication and Technology Management (CTM) Department	Division of the city that handles the communication and technology infrastructure.
University Technology Services	The office for the city's major university that handles the information technology infrastructure.
People-Finders Project	Volunteers that created a single database on missing evacuees from different information sources on the Web using open-source technologies.
Individual technology volunteers	Members of the community who worked as technology volunteers at the intake tables and public computers at the shelter.
Vendor technology volunteers	Local and multinational high-tech firms that donated computing and telephone equipment to the shelter.

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1. This is a pseudonym.
2. I use the term "relational agency" to denote that agency is theorized as shared among heterogeneous actors. There is significant variation in how shared agency has been theorized, from the acknowledgment that technologies have a "material agency" (Pickering, 1995) to the recognition of technology as an agency in its own right (Barad, 2007; Latour, 2005). I simply start with the assumption that agency is always shared among actors.
3. I seek to highlight the exclusionary nature of practice that is fundamental to Barad's (2007) approach yet underemphasized in existing constitutive entanglement approaches.

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